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(54) REMOVING MATERIAL FROM A SURFACE OR
SURFACES OF MOVING STRIP

(71) We, DAVY-LOEWY LIMITED, a British company of Prince of Wales Road, Sheffield S9 4EX, Yorkshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the removal of undesired material from a surface or surfaces of a moving elongate strip-like material hereinafter called "strip".

It is normal practice when rolling strip to apply a lubricant and/or coolant on to the mill rolls and some of this liquid tends to remain to some degree on the surfaces of the strip; undesirable staining or scratching may then result. Similarly, small solid particles are created in some rolling processes and can cause scratching of the strip surface if not removed; that is particularly the case when sintered powder is rolled dry.

Attempts have been made to remove undesired adhered material from the strip, but those attempts have so far suffered from various faults. For example, squeegees or felt pads used to remove liquid from strip have been effective, but have themselves worn rapidly and needed replacement at close intervals with the consequent loss of production while replacement is taking place. It has also been proposed to drive adherent material from the strip by the use of high powered air jets from nozzles disposed some distance from the pass-line of the strip; whilst that method has been successful in effecting removal without wear or scratching of the strip, the smoke and the noise of the high powered air jets has been most objectionable to the mill operator.

One aspect of the invention resides in a method of removing material from a surface of moving strip by the application of a gaseous fluid to the strip surface by a pneumatic pad, which is closely spaced from the surface and has a plurality of discharge openings directed towards the surface, the

supplied fluid escaping laterally between the strip surface and the pad and thereby driving off material on the surface, and which is movable towards and away from the strip surface, in dependence on fluid pressure to maintain the spacing of the pad from the strip surface. As the pad is closely adjacent the strip, the air flow may be relatively small so that the removal is accompanied by little noise.

The pad is preferably arranged so that the gaseous fluid escapes predominantly in a direction contrary to the direction of strip movement. The escaping gaseous fluid may cause liquid or particles on the strip surface to be driven toward a side or the sides of the strip.

Another aspect of the invention resides in apparatus for removing material from a surface of moving strip the apparatus comprising a pneumatic pad which is disposed closely adjacent the strip pass-line, and has a plurality of gaseous fluid discharge openings directed towards the pass-line, and which is mounted for movement towards and away from the pass-line; and means for supplying gaseous fluid under pressure to the discharge openings and thence to the space between the pad and the strip and by its escape laterally between the pad and the strip to drive material off the strip surface, the pad being moved by fluid pressure to maintain that space.

A preferred form of the invention resides in apparatus for removing material from the surfaces of a substantially horizontal strip moving along or near to a given pass-line, the apparatus comprising a first pneumatic pad disposed below and closely spaced from the pass-line, a second pneumatic pad disposed above the first pad and mounted for vertical movement away from the pass-line, the first and second pads having gaseous fluid discharge openings directed upwardly and downwardly respectively towards the pass-line, and means for supplying gaseous fluid under pressure to the discharge open-

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ings of the two pads and thence to the spaces between the pads and the strips and by its escape between the pads and the strip to drive material off the strip surfaces, the arrangement being such that, in use, the strip floats above the lower pad and the upper pad floats above the strip.

The gaseous fluid is usually air, but other gases and vapours may be used in its place.

The invention will be more readily understood by way of example from the following description of apparatus and method of removing material from strip, reference being made to the drawing accompanying the provisional specification, in which:—

Figure 1 is a section through a mill stand carrying the device for removing material adhering to the strip surfaces.

Figure 2 is a plan view partly in section corresponding to Figure 1;

Figure 3 is an end view partly in section, and on enlarged scale, of the material removing device.

The rolling mill stand illustrated in the drawing comprises two housings 2, 4 each having a window 6 which guides bearing chocks 8, 10 for rolls 12, 14 respectively. Strip S passes between the rolls 12, 14 and coolant or lubricant is sprayed on to the rolls by nozzles 16, 18 (Figure 1).

Downstream of the mill rolls is located a device for removing liquid adhering to the strip surfaces. The device comprises a pair of pneumatic pads 20, one above and one below the pass-line of the roller strip S. Each pad is formed as a bar with a number of cavities 22 in that face of the bar which is adjacent the strip. The cavities of each pad are connected through holes 24 and connecting pipes 26 to a manifold 28 or 30, and the two manifolds are in turn connected through sliding or flexible connectors 32, 34 and T-junction 36 to a source of compressed air. As seen clearly in Figure 3 those three cavities 22 which lie in the central zone of each pad 20 are connected through the pipes 26 direct to the pipe 28, but the pipes 26 of the remaining cavities at the ends of the pad include taps, valves or other restrictions 38 which enable the rate at which air is fed to those end cavities to be controlled to cater for various strip widths.

The upper pad 20 has extensions 40 formed with slots 42 and screws 44 pass freely through these slots and are threaded into the mill housings 2, 4 so that the upper bar can move vertically up and down to a limited extent. The mounting of the upper pad 20 also enables the latter to be lifted clear of the pass-line for threading of, and access to, the mill. The lower pad also has extensions 46 and screws 48 fix that bar rigidly to the mill housings.

As the strip passes through the mill stand

with its layer of coolant, small particles or lubricant on its surfaces, the air supplied to the cavities 22 in the lower pad 20 is restricted in its escape by the proximity of the strip S and, although the air escapes at the edges of the strip, an air pressure is established in the space between the pad and the strip causing the strip S to float above, and out of contact with, the pad 20. The flow of air over the lower surface of the strip S is sufficient to drive the adherent liquid and other material over the strip surface laterally of the direction of movement of the strip and towards the rolls 12, 14 so that little remains on the strip surface leaving the pad.

For greatest efficiency the air escaping from beneath the strip S may be caused to drive the liquid toward an or the edges of the strip. In the arrangement shown in the drawing, that may be effected by arranging the valves 38 so that the rate of flow to the central three cavities 22 of the pad 20 is greater than that to the outer cavities, causing a fan-shaped divergence of the residual lubricant as illustrated schematically in dotted line at F in Figure 2. Alternatively, the flow rate to all the cavities 22 may be substantially the same and the face of the pad 20 nearer the mill may be inclined at an acute angle to the direction of movement of the strip. Again, that face may have a V-profile, the centre of the pad being closest to the rolls 12, 14.

For maximum utilisation of the air supply, the lower pad 20 may carry skirts over a part only of its periphery. Thus there may be skirts at the downstream and side edges of the pad to engage the strip S and to restrict the escape of air to the upstream direction. The skirts also afford protection on the event of a temporary air supply failure.

As above stated, the strip S is normally held pneumatically out of contact with the lower pad 20, but the pressure of the air supply may in emergency be reduced so that the strip moves in contact with the pad on the downstream and side edges; for those reasons those edges may be made of a material that will not cause scratching of the strip surface.

The upper pad 20 is similar to the lower pad in construction and function and may be modified in the same way as has been described in relation to the lower pad. As illustrated in Figure 3, the air pressure developed between the upper pad 20 and the strip S is sufficient to cause the pad 20 to "float" above, and out of contact with, the strip and at the same time remove the residual lubricant from the surface thereof.

With correctly proportioned sizes of cavities and pressure of air the strip is cleaned effectively on both faces and the small gaps

between the air-cushioning pads and the strip ensures a minimum amount of noise from the compressed air and the absence of scratching of the strip.

5 The pads may be formed of any suitable material, e.g. wood, or a plastics material, or aluminium.

10 In some installations, it may be desirable to have pneumatic pads, similar to those described and illustrated at 20, located at the entry side of the mill. For example, the coolant sprayed on to the rolls by the nozzles 16 tends to flow back on the surface of the strip away from the mill, particularly at start up when the sprays are put into operation before the mill drive, and causes operational problems. The provision of the pneumatic pads at the entry side, by preventing upstream flow of the coolant largely eliminates those problems. The entry side pneumatic pads may be in addition to those at the exit side, or may be the only such pads on the mill.

WHAT WE CLAIM IS:—

25 1. A method of removing material from a surface of moving strip by the application of a gaseous fluid to the strip surface by a pneumatic pad, which is closely spaced from the surface and has a plurality of discharge openings directed towards the surface, the supplied fluid escaping laterally between the strip surface and the pad and thereby driving off material on the surface, and which is movable towards and away from the strip surface, in dependence on fluid pressure to maintain the spacing of the pad from the strip surface.

40 2. A method of removing material from the surfaces of moving strip by the application of gaseous fluid to the strip surfaces by a pair of pneumatic pads between which the strip is caused to move with the surfaces closely adjacent the pads, and each of which has a plurality of fluid discharge openings directed towards the surface, the supplied fluid escaping laterally between the strip surfaces and the pads and thereby driving off material on the surfaces, one of the pads being movable towards and away from the other pad, whereby the spacing of the strip from said other pad and the spacing of said one pad from the strip are maintained by fluid pressure.

55 3. A method of removing material according to claim 2, in which the strip surfaces are substantially horizontal, the pneumatic pads are located above and below the strip, and the upper pad is vertically movable, its weight being balanced by the pressure subsisting between it and the strip.

60 4. A method of removing material according to claim 3, in which one of the pads has a skirt engaging the strip over a part only of the periphery of the pad.

65 5. A method of removing material

according to claim 4, in which the strip so engages the skirt that the fluid escapes in the upstream direction of the strip.

70 6. A method of removing material according to any one of the preceding claims, in which the material is driven towards one edge of the strip.

75 7. A method of removing material according to claim 6, in which one edge of the pad, or each pad, is disposed at an acute angle to the direction of movement of the strip.

80 8. A method of removing material according to any one of claims 1 to 5, in which one edge of the pad or each pad has a V-shape and the material is driven towards the edges of the strip.

85 9. A method of removing material according to any one of claims 1 to 5, in which the centre of the pad, or each pad, is supplied with fluid at greater rate of flow, relative to the ends of the pad.

90 10. Apparatus for removing material from a surface of moving strip, the apparatus comprising a pneumatic pad which is disposed closely adjacent the strip pass-line, and has a plurality of gaseous fluid discharge openings directed towards the pass-line, and which is mounted for movement towards and away from the pass-line, and means for supplying gaseous fluid under pressure to the discharge openings and thence to the space between the pad and the strip and by its escape laterally between the pad and the strip to drive material off the strip surface, the pad being moved by fluid pressure to maintain that space.

105 11. Apparatus for removing material from the surfaces of a substantially horizontal strip moving along or near to a given pass-line, the apparatus comprising a first pneumatic pad disposed below and closely spaced from the pass-line, a second pneumatic pad disposed above the first pad and mounted for vertical movement away from the pass-line, the first and second pads having gaseous fluid discharge openings directed upwardly and downwardly respectively towards the pass-line, and means for supplying gaseous fluid under pressure to the discharge openings of the two pads and thence to the spaces between the pads and the strip and by its escape between the pads and the strip to drive material off the strip surfaces, the arrangement being such that, in use, the strip floats above the lower pad and the upper pad floats above the strip.

115 12. Apparatus according to claim 11, in which some of the discharge openings have flow-rate control means in their connections with the supplying means.

125 13. Apparatus according to claim 11 or claim 12, in which one or each of the pads has an edge disposed at an acute angle across the pass-line.

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14. Apparatus according to claim 11, in which at least one of the pads has a skirt round a part only of the periphery and extending towards the pass-line.
- 5 15. Apparatus according to claim 11, in which a part only of the periphery of at least one of the pads extends closer to the pass-line than the remainder of the periphery.
- 10 16. Apparatus according to any one of claims 10 to 15, in which the pad or pads are located downstream of a rolling mill for the strip to remove the material from the surface or surfaces of the strip leaving the mill.
- 15 17. Apparatus according to claim 16, in which there is, in addition, a pad or pads similar to that or those downstream of the mill, but located at the upstream side, in order to prevent upstream movement of material on the surface or surfaces of the strip.
- 20 18. Apparatus according to any one of claims 10 to 15, in which the pad or pads is or are located upstream of a rolling mill for the strip to prevent upstream migration of material on the surface or surfaces of the strip entering the mill.
19. The combination of the apparatus according to any one of claims 10 to 15, and a rolling mill having horizontal rolls and provided with spray nozzles for directing coolant liquid on to the rolls at the entry side of the mill, and the pad or pads is or are located upstream of the mill to prevent upstream migration of the coolant liquid at least on the upper surface of the strip.
20. A method of removing material from the surface of moving strip, substantially as herein described with reference to the drawing accompanying the provisional specification.
21. The combination of a rolling mill for rolling strip and a device for removing material from the strip surface, substantially as herein described with reference to the drawing accompanying the Provisional Specification.
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